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best definition of value or worth, and that it should be adopted as the scientific meaning of the term.

At any rate, a discussion on this topic is most timely. The basic idea of the modern labor movement is the idea that workmen do not get an *equivalent* (equal value) for what they produce. If scientific men are to take any hand in practical politics or applied sociology, this is the point where their work is most required at present.

E. LANGERFELD.

New York, March 26.

The destructive caterpillars of the squares of New York.

Since the importation into America of the quarrelsome, active, and noisy English sparrows, which have driven the quiet and brilliant birds of the south from the city gardens and parks, a new prolific horde, with fierce appetites, every year more extended, threatens to destroy our fresh and green shade-trees.

As early as 1882 the *New York evening telegram* sounded a note of alarm on this subject, to which we added another, but without effect. When nature threw off its summer mantle, and this ravaging army quietly took up its winter quarters, every thing seemed to be forgotten, and our modest communication no doubt went into the pigeon-hole of oblivion; nevertheless, we try again.

After three years' study of the devastating habits of caterpillars, we tried to engage the attention of the committees having charge of the city parks; but to no purpose, for in the summer of 1883 the enemy had greatly multiplied. After some years of neglect, it was too late to save from destruction the plants which had become insufficient to feed the successive broods of myriads of caterpillars. The new-comers soon got beyond the city limits; and once getting a foothold in the suburbs, science, the fruit of observation, could no longer keep within bounds the voracity of these unattackable hairy pests.

The damage of one year may be unlike that of the preceding or following; atmospheric changes may destroy multitudes; but the enemy is prolific, and will in a year increase ten, a hundred fold, and even more.

As the press of New York and even intelligent citizens may think that this enemy has disappeared, we raise a new cry of alarm, addressing ourselves to the learned societies of our adopted country, at the same time communicating the results of our studies to intelligent readers interested in the natural sciences. Our statements will be based on facts observed by us in New York, supported by the testimony of learned colleagues with whom we (myself and son) have corresponded for more than two years, during which we have studied the increasing ravages of this coquette with brilliant, silky, and variegated dress which science names the *Orgyia* caterpillar.

When the European sparrow was first introduced into the parks of New York, a caterpillar was there committing great depredations. Linnaeus called it the geometer: we call it looper, spanner, and canker-worm. The larva has six feet on the first three segments, and four on the last two, and as it progresses seems to measure the ground. The sparrows were very fond of this caterpillar, to a degree that their increasing numbers speedily exterminated it: for this they deserve our gratitude. It was different

with the larvae of the *Orgyia*. Consequently we have thought it might be of interest to the public to say a little of what is known of the habits of the first as compared with the second equally destructive species. The first still exists in many private gardens in New York.

Phalaenidae.—The butterflies which come from the larvae of the geometers almost all have the body slender, the thorax narrow, and wings proportionally wide; their flight being consequently more uneven and jerky, more unsteady, than that of the nocturnal species: the flight, in fact, is more like that of the diurnal ones, but is neither so strong nor of long duration, on account of the comparative weakness of the framework of the wings. They especially like serene and still evenings and nights. But there are to this characterization many exceptions. Some of the *Phalaenian* larvae have 12 legs, and some even 14; among the nocturnal species, again, some have 12 and others 14 legs; the general rule being 16 legs among the nocturnal, and 10 among *Phalaenians*. It is also a curious fact that the larvae of those with 16 legs loop in progressing, for some reason making no use of the intermediate legs.

Another kind of exception is that some *Phalaenians* which are nocturnal, a small number it is true, have a diurnal flight; that is to say, that certain species fly in full sunlight, gathering food on flowers in company with diurnal butterflies: so that the division into diurnal and nocturnal species is, in this respect, conventional. It is, however, true that day butterflies have almost always the antennae club-shaped, and come from larvae with 16 legs; while the *Phalaenians*, whose larvae have 10, 12, or 14 legs, have filiform or pectinated antennae.

There are in Europe some 600 *Phalaenians*, 700 nocturnal, and 400 diurnal butterflies; though it is probable that in hot climates the diurnal are more numerous than in the temperate. The *Phalaenians*, especially in cold regions, have usually sombre colors, gray or black, though there are many exceptions. In France there is a large and handsome green species, which is a common symbol on the tombs of children, probably on account of its delicate form and color. They hatch at all seasons of the year: there is even a group (*Hybernidae*) which appears in December, January, and February. The *Phalaenians* may emerge from the pupa even below 50° F., while the others, and especially the diurnal species, require at least this temperature.

In Hibernia we find a singular fact. The females have either no wings, or semi-wings unfit for flight. As the pupa is generally in the earth, the female, on emerging, crawls up the nearest tree, where pairing takes place; the male bearing her to the top of the tree, and sometimes carrying her off in his flight. The females are small; and the males, much larger, deposit them in places proper for the support of the larvae,—buds of flowers, or masses of leaves, according to the species. There are in this group some veritable pests for man. The *H. de foliaerio* sometimes so destroys the leaves of forest-trees, that, unable to respire, they either die or partially wither. The *H. brumata* consumes every thing in the orchards, attacking the flowers of all kinds of fruit-trees.

It would be interesting, but impossible here, to speak of the habits of many of these butterflies, and to note their exceptional characters; but a single example must suffice. There is among the *Phalae-*

nians a group of about one hundred species, all with different habits, — the *Eupithecia*, studied for many years by M. Goossens of Paris, from whom these details are taken. The *E. rectangularia*, so named from the design of the upper wings, emerges from the pupa at Paris in April. After pairing, the female deposits an egg in the midst of the flower of an apple, pear, or quince tree. The egg, which is yellow, is well hidden in the heart of the flower, and is hatched in a few days. The larva, hardly visible to the naked eye, is of a rosy-white color, and begins its work by attaching one end of a thread to the top of a petal, and the other to the heart of the flower; by its traction the petal being bent down. The same is done with the five petals; and the larva is thus enclosed, protected from wind, rain, and parasites. It can with impunity devour the base of the flower and of the petals. The pollen of the male flower cannot fecundate the female flower, which is the one selected by the larva, and consequently there is no reproduction and no fruit. As the eggs have been widely scattered by the female's instinct, a few of these insects may render abortive the flowers of an orchard, or even of a region, without any reasonable explanation for the horticulturist. So many similar insects attack in this or other ways our fruit-trees, that in some places it is an astonishing event to see an apple on a tree.

While remembering that the European sparrows have done great service to New York by destroying the larvae of the geometers, or canker-worms, almost all of which are bare and smooth, it must be said that they are useless, and even injurious, in presence of the larvae of *Orgyia*. Sparrows, like most birds of the genus, do not like the hairy larvae, from the irritation they cause in the throat and stomach. One may frequently see poultry seize such larvae, kill them by beating them on the ground, and then leave them without eating them.

Bombycidae. — In this family belongs the larva which of late years has been so destructive in the parks and gardens of New York. For a long time we sought to discover its place of origin, how it arrived here, became acclimated, and multiplied to such an astonishing degree without meeting the parasite which destroys it. At first we thought it had been imported from France, where a species of the group, *Orgyia antiqua*, had been known in the Paris squares for several years, devouring trees and shrubs, and sometimes a pest among the rose-bushes. After having carefully compared it, with the aid of M. Goossens of Paris, it seemed to come very near to, if not to be, the *O. vetusta*, — a species common in California, which places its cocoons in the interstices of the bark of trees, the grooves of lamp-posts, cracks in wooden fences, and also between the hoops on wine-casks on the wharves. In the last way, the insect, which does not bear transportation well, might be carried even across the continent or the ocean. Without the necessity of this derivation, it has now been ascertained that the species is *O. leucostigma* Smith, which occurs in the neighborhood of Davenport, Io. (see Proceedings of the Academy of natural sciences, 1867–78, Davenport, Io., vol. i. p. 177). This may be found much nearer.

It is precisely at its youngest age that the life of the insect is best protected. An egg, according to Reaumur and others, will endure a cold of 50° below freezing, and the boiling-point of water in heat, without losing its vitality. In this age there being

no means of defence or escape, a species would soon be destroyed without these natural means of resistance. After hatching, the larvae are dispersed, and conceal themselves in places resembling them in color, until the survival of the species is assured. Nature always furnishes efficient protection when most needed.

Before taking up the *Orgyia* larva, we wish to speak of a parasite which we discovered, — an inoffensive dipterous insect, all of whose metamorphoses we have studied, which would soon destroy the larvae, if the sparrows, in their turn, did not become the persistent and greedy devourers of said parasite.

At the two seasons of the year when the larva makes its appearance in New York, this dipterous insect is on the watch, and as it crawls along the ground deposits an egg in the midst of its hairy covering. Toward the end of winter or beginning of spring the dipterous larva is developed at the expense of the *Orgyia* pupa. Then, instead of a moth being hatched, appears an active fly with extended wings, large enough to be observed by the naked eye. Precisely at this moment the sparrows hunt them, devouring great numbers, which, if allowed to multiply by this strange manner of hatching, would soon much reduce the number of the *Orgyia*, if they did not completely destroy the species. Here comes in the reflection that the sparrows are now not only useless, but actually aid in the multiplication of the destructive *Orgyia*.

But not to completely ostracise these noisy and vivacious strangers from the land where, with so many of my countrymen, they have been so hospitably received, let them remain as long as the people care to protect them; inasmuch as, without disturbing them in their picturesque dwellings, there is a way of destroying the *Orgyia*, by an anodyne and easy process, doing no harm either to plants or animals, nor to the visitors of the beautiful parks of the city. Nothing is more disagreeable to the fair promenaders than to feel upon the neck, see suspended from their head-dress or hair, or crawling over their dresses, these little creatures, interesting to the scientific observer, but causing a shudder to them.

The larvae of *Orgyia* know well the laws of aërostation, and the use of the parachute. M. Capronnier of Belgium, a few years ago, in the month of October, made this singular observation on the method of their dispersion. It must be remembered that the females of *Orgyia* are wingless, — a character which distinguishes them from the genus *Liparis*, in which the females have wings. The question was asked how the *Orgyia* could gain access to an enclosure newly cultivated. M. Capronnier replied that he had seen the small larvae emerge from eggs laid in the cocoon of *Orgyia*. They made a thread from which they suspended themselves free in the air, when the wind carried off the larvae with the thread, no doubt to great distances, and they very soon disappeared. This mode of dispersion is similar to that observed in some spiders.

The genus *Orgyia* was established by Ochsenheimer, and belongs to the Bombycidae, or those whose larvae make cocoons from their own hairs, or particles of earth hardened by a salivary secretion, etc. The adults are of small size. The males, of rich colors usually, fly rapidly in full sunlight; the antennae wide, bipectinated, doubtless with an acute sense of smell, which guides them to the females. The last are five or six times as large as the males,

heavy, full of eggs, motionless, having not even an embryonic trace of wings. The larvae which are to become males, beside some differences in colors, are much smaller as pupae than those which are to become females. As soon as the perfect stage arrives, the males commence their flight, while the females simply emerge from their cocoon, on which they remain, attracting the males by an odor which they emit, inappreciable to our senses, but shown to exist by the fact that the males will enter an apartment in which a female is imprisoned in a tin or wooden box. The males move their antennae vigorously during flight, often bending them forward, and approach the windows. If these be closed, they go around the house in search of an entrance: they have even been known to descend the chimney.

Pairing is accomplished in a very rough manner. Among many Sphingidae the males approach gently, attract attention, departing and returning in circles, gradually diminishing, until union takes place; but in these the contact is rude, almost brutal, and the female, after the departure of the male, remains motionless, and begins to lay her eggs on the cocoon. *O. antiqua*, of France, lays its eggs near the cocoon, where they become attached by a secretion which covers them as they are laid. *O. gonostigma* lays her eggs near the cocoon, taking hairs from its body to make a bed for them, in alternate layers of hairs and eggs, till all are deposited, to the number of about three hundred. The New York species covers the eggs with a white viscid secretion, solidifying in the air, resembling the mucus of the snail and slug. The eggs are generally pretty, at first round, then indented at the top like a goblet or cup, sometimes with a rose-colored ring (in *O. antiqua*), sometimes of a porcelain-white tint (in *O. vetusta*).

The larvae escape from the egg by eating through the bottom, where the holes for fecundation are placed. They do not disperse themselves widely. As they live on trees and shrubs, are not large, and eat little individually, they may be numerous upon a single plant. Moreover, almost all are polyphagous, or will eat many different kinds of plants. In France, however, the *O. ericaea* lives only upon heaths, and the *O. trigotephras* on a species of oak.

Some species have several broods a year. The *O. antiqua*, in Paris, like the New York species, appears in June, and sometimes in October; others have only a single brood; but this cannot be made use of in classification or physiology. A given species may have but one brood in the north of Europe and America, and two in the south; and even in Paris and New York, when September is very warm, a second brood may appear, which would not occur in many other Lepidoptera. In captivity, also, the absence of cold nights changes the epochs of their appearance, besides favoring the development of a second brood.

Linnaeus says that the male of the *Orgyia*, knowing by instinct that the wingless female is powerless to move far, when he finds her on a wall or plant, flies away with her during pairing, and carries her to a place where the young may obtain food. This we have never seen, and never expect to, as the males are entirely too small and feeble to carry off the much greater bulk of the female. We need not say any thing here of the *O. detrita*, which resembles much the *O. vetusta* or *leucostigma*, and may be the same species. LE METAYER DE GUICHAINVILLE.

New York, March 22.

Fossils from Kicking Horse Pass.

I have to-day received the following very interesting communication from Professor Lapworth, on the result of an examination he has kindly made for the survey, of a collection of graptolites from the Rocky Mountains, in the vicinity of the Kicking Horse Pass.

ALFRED R. C. SELWYN.

Geol. surv. Can., March 15.

I have recently examined the fossils collected by R. G. McConnell, geological survey of Canada (1886), from the dark, slaty shales of the Kicking Horse Pass, Rocky Mountains. There are few species in the fairly large collection, but the forms are generally well preserved, and the fauna represented is a distinctly typical one. The following are the species I have identified:—

(A) Family Dichograptidae.

- (1) *Didymograptus*, sp. nov., allied to *Didymograptus enodus* Lapworth from the Llandeilo beds of Abersiddy Bay, South Wales (see *Quart. Journ. geol. soc.*, 1875, plate 35, figs. 1a, 1b).

(B) Family Glossograptidae.

- (2) *Glossograptus ciliatus* Emmons.

- (3) *Glossograptus spinulosus* Hall.

(C) Family Diplograptidae.

- (4) *Cryptograptus tricornis* Carr or *C. marcidus* Hall.

- (5) *Diplograptus angustifolius* Hall.

- (6) *Diplograptus rugosus* Emmons.

- (7) *Climacograptus coelatus* Lapworth.

There are also a few other forms, doubtful.

Species of Phyllograptus or Lasiograptus, etc.

The fact that these graptolites have been obtained from the distant region of the Rocky Mountains gives them an especial interest, as few graptolites have hitherto been noticed from that region. The only notice of graptolites from the western states known to me is that given by Dr. Charles White in vol. iv. ('Palaeontology') of the 'Report of the geological survey of the hundredth meridian.' Four forms are described by him (*loc. cit.*, pp. 9, 10, *et seq.*) as having been obtained from some beds of partially metamorphosed shale five miles north of Belmont, Nev. No fossils were found associated with them that might assist in the determination of their exact age; and they were provisionally referred to the geological date of the Utica slate of New York state.

These graptolites from the Kicking Horse Pass, under notice, may also be referred to the age of the Utica slate, or at any rate to the Trenton. In the Utica fauna of the United States and Canada the association of forms is just such as occurs in the Llandeilo (lower and middle) of Britain, and some of the forms are common to both sides of the Atlantic.

It is curious that none of the family of the Dicanograptidae (*Dicanograptus* and *Dicellograptus*) are represented in this little collection. It is just possible that it may therefore be somewhat older than the typical Norman's Kiln beds, where the *Dicanograptidae* are exceedingly abundant. Neither have we any of the peculiar genera of the *Leptograptidae* (*Coenograptus* and *Leptograptus*, etc.) so prevalent in the Norman's Kiln horizon everywhere. Thus it is by no means unlikely, judging from the evidences at present at our disposal, that the fauna of the shales of the Kicking Horse Pass come from strata answering broadly to the British lower Llandeilo: they are distinctly newer than the Point Levis beds, and belong to the second Ordovician fauna, but in all probability to the oldest zones of that fauna.

CHAS. LAPWORTH.

Mason college, Birmingham, March 7.